REMARKS

This paper is being provided in response to the Office Action mailed November 11, 2005, in which of claims 1-37 that were pending in the application, claims 38-115 are withdrawn from consideration and claims 1-37 are rejected. The deadline for responding to this Office Action was February 8, 2006. A Petition for a three (3) month extension of time up to and including May 8, 2006, is submitted herewith. Claim 1 has been cancelled. Claims 2, 4-7, 11-21, 24-36 have been amended. New claims 116-119 have been added. Applicant respectfully submits that the amendments to the claims do not add new subject matter.

Brief Description of the Invention

The present invention relates generally to microfluidic chemical systems for synthesis and coating of colloidal nanoparticles. Specifically, the present invention integrates microchemical systems to synthesize colloidal nanoparticles, tune their surface properties, composition and crystallinity, into one integrated substrate.

Claim Objections

Claims 3 and 14 were objected to because of informalities. Examiner states that "emersed" in claim 3 should be changed to "immersed." Applicant respectfully submits that "emersed" is proper in claim 3, and is defined to mean standing out of, or rising above a surface (as of a fluid). Examiner further states that "are" in claim 14 should be changed to "is." Applicant again respectfully submits that "are" is proper in claim 14 because the claim recites "more than one reactant stream" which is a plurality of objects. Applicant respectfully requests that these objections be withdrawn.

Rejections under 35 U.S.C. § 112

Examiner has rejected claims 1-37 as being indefinite under 35 U.S.C. § 112. Specifically, Examiner has stated that claims 15-18 and 27-36 are directed to method limitations which render the claims vague and indefinite. Claims 1, 4 and 36 lacked antecedent basis. Examiner stated that claims 19-26 and 37 were unclear as to their structural limitations.

Claim 1 has been cancelled. Claims 2, 4-7, 11-21, 24-36 have been amended, and new claims 116-119 have been added. Applicant submits that the amendments and new claims obviate these rejections. Applicant therefore respectfully requests that these rejections be withdrawn.

Rejections under 35 U.S.C. § 102

Barbera-Guillem:

Claims 1, 17, 11-30 and 33-37 are rejected under 35 U.S.C. § 102(b) as being anticipated by Barbera-Guillem et al. (U.S. Patent No. 6,179,912). Barbera-Guillem discloses a system and continuous flow process for producing monodisperse semiconductor nanocrystals. As shown in Figs. 1-3 and described in column 8, line 24 through column 9, line 14 of Barbera-Guillem, the system is comprised of "individual parts" including, e.g., a first reactor (illustrated is first reactor 12); a second reactor (illustrated is second reactor 14); a growth termination path (illustrated is growth termination path 16); and an outlet path (illustrated is outlet path 18); etc. *See* col. 8, lines 38-41. As shown in Figs. 1 and 2, Barbera-Guillem discloses or suggests a modular system, wherein the various components "are connected or otherwise operatively linked to maintain a variably controlled, closed environment in providing a continuous flow process for the production of semiconductor nanocrystals." *See* col. 8, lines 41-45. Barbera-Guillem further discloses that "[t]he detailed relationship between the individual parts *is not critical to the invention*, insofar as to whether they be manufactured as separate components which are then fabricated or operably linked to form the system, or as an integral body portion which forms the system." *See* col. 8, lines 45-50 (emphasis added); *see also* col. 8, lines 56-59 ("Generally, the material which forms each individual part of the system…").

The present invention relates generally to microfluidic chemical systems for synthesis and coating of colloidal nanoparticles. Specifically, the present invention integrates into one integrated substrate, various microchemical systems to synthesize colloidal nanoparticles such as Silica, Titania, Alumina or Ceria, tune their surface properties, composition and crystallinity, and control their self-assembly. *See, e.g.*, page 2, lines 22-28 and Fig. 4. For example, as claimed in independent claim 116, the various components of the microreactor system of the present invention comprise at least one colloidal nanoparticle, at least one micromixing block positioned

downstream from said at least one inlet channel, an ageing section positioned downstream from said at least one micromixing block, and at least one colloidal nanoparticle, wherein all of the said components reside on one integrated substrate. *See, e.g.*, page 2, line 30-page 3, line 3. The capability to integrate several functional units into one device using microfabrication greatly reduces the complexity of such multistep synthesis systems. The at least one colloidal nanoparticle may be an amorphous or organic oxide such as Silica, Titania, Alumina or Ceria, and all of the said components are microfabricated onto and integrated within one silicon wafer. *See* page 2, lines 22-28; page 13, line 8-page 15, line 17; page 22, line 1-page 23, line 28; Fig. 4.

Barbera-Guillem does not disclose, teach or suggest the apparatus of the present invention as claimed in independent claim 116. Specifically, Barbera-Guillem does not disclose a microreactor system comprising at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel *residing on one integrated substrate*. Currently pending claims 2-37 and 117-119 depend from claim 116. Applicant therefore submits that the present invention is not anticipated by Barbera-Guillem, and respectfully requests that these rejections be withdrawn.

Zehnder:

Claims 1, 7-13, 15-30 and 33-37 are rejected under 35 U.S.C. § 102(b) as being anticipated by Zehnder et al. (Patent Publication Number US 2002/0083888). Like Barbera-Guillem, Zehnder discloses a system and continuous flow process for producing monodisperse semiconductor nanocrystals. Specifically, Zehnder discusses the manufacture of nanocrystals accomplished by first dissolving or dispersing precursor materials capable of reacting to form nanocrystals in a solvent, and introducing the resulting reaction mixture into a reaction tube that is embedded or immersed in a heat transfer medium.

As stated above, the present invention relates generally to microfluidic chemical systems for synthesis and coating of colloidal nanoparticles. Specifically, the present invention integrates into one integrated substrate, various microchemical systems to synthesize colloidal nanoparticles such as Silica, Titania, Alumina or Ceria, tune their surface properties, composition and crystallinity, and control their self-assembly. *See, e.g.*, page 2, lines 22-28 and Fig. 4. For example, as claimed in independent claim 116, the various components of the microreactor

system of the present invention comprise at least one colloidal nanoparticle, at least one micromixing block positioned downstream from said at least one inlet channel, an ageing section positioned downstream from said at least one micromixing block, and at least one colloidal nanoparticle, wherein all of the said components reside on one integrated substrate. *See, e.g.*, page 2, line 30-page 3, line 3.

Zehnder does not disclose, teach or suggest the apparatus of the present invention as claimed in independent claim 116. Specifically, Zehnder does not disclose a microreactor system comprising at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate. Currently pending claims 2-37 and 117-119 depend from claim 116. Applicant therefore submits that the present invention is not anticipated by Zehnder, and respectfully requests that these rejections be withdrawn.

Masel:

Claims 1, 7, 11 and 12 are rejected under 35 U.S.C. § 102(b) as being anticipated by Masel et al. (U.S. Patent No. 6,193,501). Masel discloses a microcombustor, specifically designed to overcome both thermal quenching and chemical quenching of microcombuster flame. Masel does not disclose, teach or suggest an apparatus for synthesizing nanoparticles. Specifically, Masel does not disclose a microreactor system comprising at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate, nor can the device of Masel be modified to be a microreactor system as claimed in the present application. For example, the nozzle of Masel is specifically designed to mix liquid and gas via turbulent mixing. *See* page 3, lines 10-15 and page 6, lines 1-15. The apparatus of the present invention comprises a system that mixes two liquids that react to form solid particles such as colloidal nanoparticles or the equivalent thereof. Currently pending claims 2-37 and 117-119 depend from claim 116. Applicant therefore submits that the present invention is not anticipated by Masel, and respectfully requests that these rejections be withdrawn.

Rejections under 35 U.S.C. § 103

Barbera-Guillem or Zehnder in view of Yasuda:

Claims 2 and 4 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Barbera-Guillem or Zehnder in view of Yasuda et al. (U.S. Patent No. 6,244,738). Yasuda discloses an apparatus for mixing and stirring a fluid in a channel by radiation and ultrasound. Yasuda does not disclose, teach or suggest the apparatus of the present invention as claimed. Furthermore, as described above, neither Barbera-Guillem nor Zehnder, taken alone or in combination, disclose a microreactor system comprising at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate. Applicant respectfully submits that Yasuda does not overcome the above-noted deficiencies of Barbera-Guillem and/or Zehnder with respect to Applicant's presently claimed invention. Yasuda does not disclose, teach or suggest a system for synthesizing and coating colloidal nanoparticles (or any equivalent thereof). Applicant further submits that it would not be obvious to one of ordinary skill in the art to combine the references, as Barbera-Guillem and/or Zehnder does not disclose at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate, and Yasuda does not discuss or suggest synthesis and coating of colloidal nanoparticles. Therefore, Applicant respectfully requests that the Examiner reconsider and withdraw these pending rejections.

Barbera-Guillem or Zehnder in view of Yasuda and in further view of Chandler:

Claim 3 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Barbera-Guillem or Zehnder in view of Yasuda and further in view of Chandler et al. (U.S. Patent No. 6,506,584). Chandler discloses an apparatus and method for ultrasonically treating a liquid to generate a product. Chandler does not disclose, teach or suggest the apparatus of the present invention as claimed. Furthermore, as described above, neither Barbera-Guillem, Zehnder, nor Yasuda, taken alone or in combination, disclose a microreactor system comprising at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate. Applicant respectfully submits that Chandler does not overcome the above-noted deficiencies of Barbera-Guillem, Zehnder and/or Yasuda

with respect to Applicant's presently claimed invention. Chandler does not disclose, teach or suggest a system for synthesizing and coating colloidal nanoparticles (or any equivalent thereof). Applicant further submits that it would not be obvious to one of ordinary skill in the art to combine the references, as Barbera-Guillem and/or Zehnder does not disclose at least one colloidal nanoparticle, and further comprising an inlet channel, micromixing block, ageing section, and outlet channel residing on one integrated substrate, and neither Yasuda nor Chandler discuss or suggest synthesis and coating of colloidal nanoparticles. Therefore, Applicant respectfully requests that the Examiner reconsider and withdraw these pending rejections.

Based upon the above, Applicant respectfully requests that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4054. Please charge any fees associated with this filing, or apply any credits, to our Deposit Account No. 03-1721.

Respectfully submitted,

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